

## REMARKS

Claims 1, 7 and 9-21 remain pending. Arguments for the patentability of the claims over the prior art newly cited in the Office Action of June 25, 2009 are presented. For reasons stated in detail below, Applicants respectfully submit that the present application is in condition for allowance.

### **I. Claim Rejections - 35 USC §103(a)**

*A. In the non-final Office Action dated June 25, 2009, claim 1 is rejected under 35 USC §103(a) as being obvious over JP 63-210291 A (published August 1988) in view of JP 62-030615 A (published February 1987).*

Claim 1 of the present application is directed to copper sulfate which is required to have:

(i) a purity of 99.99wt% or higher;

(ii) contents of Ag impurities of less than 0.01wtppm;

(iii) contents of metalloid element impurities of As, Sb, and Bi of less than 0.1wtppm, respectively;

(iv) contents of radioactive elements of U and Th of less than 0.001wtppm, respectively; and

(v) contents of heavy metal elements of Fe, Cr, and Ni of less than 0.1wtppm, respectively.

It is stated in the Office Action that JP '291 discloses copper sulfate having an Ag concentration of 0.1 ppm "or less" and that JP '615 discloses a copper sulfate having a purity of 99wt% "or more" and having "low concentrations" of Ni, Fe and "water insolubles". It is then reasoned that it would have been obvious to one of ordinary skill in the art at the time of the invention to "optimize" these teachings and to "combine the teachings of Maekawa (JP '615) with the teachings of Kawasumi (JP '291)". Applicants respectfully disagree with this

conclusion and respectfully request reconsideration and removal of this combination and obviousness rejection.

JP '291 (Kawasumi) relates to a method of “desilvering or collecting Ag” from an aqueous solution containing Ag ions. More specifically, JP '291 discloses a method of producing electrolytic copper including the steps of performing electrolytic treatment with a low current (i.e., “applied d.c. of 0.2A”) to an Ag-containing solution with the base metal (Cu) of the solution as the cathode and an insoluble electrode as the anode to selectively remove Ag from the solution. JP '291 also discloses a copper sulfate having a content of Ag as an impurity of 0.1ppm “or less”.

The primary reference, JP '291, clearly **fails** to disclose copper sulfate having: (i) a purity of 99.99wt% or higher; (ii) contents of metalloid element impurities of As, Sb, and Bi of less than 0.1wtppm, respectively; (iii) contents of radioactive elements of U and Th of less than 0.001wtppm, respectively; and (iv) contents of heavy metal elements of Fe, Cr, and Ni of less than 0.1wtppm, respectively.

Accordingly, in the Office Action in an attempt to overcome the deficiencies of the primary reference, JP '291 is required to be “combined” with JP '615 in order to make the above referenced obviousness rejection.

JP '615 discloses a method stated as being “cheap” or “inexpensive” for producing copper sulfate. More specifically, JP '615 discloses steps of using electrolytic copper as an anode, placing the anode and a cathode in a diaphragm bag, performing electrolysis with 0.3 to 1.1mol/l of sodium sulfate aqueous solution with a pH of 5 to 13 as the electrolytic solution at a temperature of 55 to 75° and a cathode current density of 150-300 A/m<sup>2</sup>, filtering the produced copper (II) oxide powder (“cupric oxide”), dissolving the obtained powder in sulfuric acid,

heating/condensing and/or cooling the solution, and filtering the produced crystals to obtain copper sulfate.

The method disclosed in JP '615 is said to produce a copper sulfate having 99.0wt% "or more" and concentrations of each of Ni and Fe impurities of "below" 10ppm (which corresponds to 0.001wt%).

First, Applicants respectfully submit that it would not be obvious to one of ordinary skill in the art, at the time of the invention, how the teachings of these references could be "combined". JP '291 clearly requires a cathode made of copper and an anode made of an insoluble electrode. In contrast, JP '615 clearly requires an anode made of electrolytic copper. Further, JP '291 requires use of a low current (0.2A DC); whereas, JP '615 requires a cathode current density of 150-300 A/m<sup>2</sup>. Accordingly, it would not be obvious to one of ordinary skill in the art to combine the teachings of JP '291 and JP '615 because the processes are clearly different. It is not clear how they could be combined or if they could be combined, and it is not clear what the result would be. Unless the underlying processes are obvious to combine, the desired characteristics of the copper sulfate produced by different processes cannot simply be combined. Accordingly, Applicants respectfully request reconsideration and removal of the rejection based on the combination being non-obvious.

Secondly, without respect to the references being non-obvious to combine, the combination still **fails** to teach or render obvious copper sulfate having: (i) contents of metalloid element impurities of As, Sb, and Bi of less than 0.1wtppm, respectively; (ii) contents of radioactive elements of U and Th of less than 0.001wtppm, respectively; and (iii) contents of Cr of less than 0.1wtppm. There is simply no disclosure, teaching, suggestion, motivation or common sense reason.

Also, it is not fair to conclude that the combination of JP '291 and JP '615 would inherently have these concentrations because the purification processes of the cited references rely solely on electrolysis which is entirely different to that of the present invention which uses the combination of solvent extraction and active carbon treatment. Thus, it is clear that one of ordinary skill in the art would not expect the same purity level and that it would not be obvious to one of ordinary skill in the art to obtain these concentrations from the cited prior art.

Finally, Applicants respectfully submit that the limitations of claim 1 requiring: (i) a purity of 99.99wt% or higher; (ii) contents of Ag impurities of less than 0.01wtppm; and (iii) contents of Fe and Ni of less than 0.1wtppm, respectively, provide unexpected results and that such limitations are not obvious in view of the cited combination of references.

It should be noted that claim 1 of the present application requires purity at a 99.99wt% level, not merely the 99.0wt% level disclosed by JP '615. In addition, claim 1 of the present application requires Ag content at a level of 0.01wtppm, not merely at a 0.1ppm level disclosed by JP '291. Still further, claim 1 of the present invention requires contents of each of Fe and Ni at a level of 0.1wtppm, not at a level of 10ppm as disclosed by JP '615.

From the written Office Action, it is clear that the terms "or less" and "or more" in the phrases "0.1ppm or less" of Ag and "99.0wt% or more" purity are being given great significance. For instance, it is believed that these phrases are being interpreted to provide enabling disclosures of an Ag content of 0.1ppm to absolutely zero and a purity of 99.0wt% to 100wt%. These ranges are simply not possible and are not enabled by the references. Rather, the "or less" and "or more" phraseology merely requires the Ag content to be at a 0.1ppm level, and not above this level, and the purity to be at the 99.0wt% level, and not below this level. Applicants respectfully submit that this represents a more realistic and honest interpretation of the language

of the cited references. Accordingly, Applicants respectfully request fair reconsideration of the interpretation of the terms “or less” and “or more” as used by the cited references.

The present invention is directed to copper sulfate for use as an electroplating solution for plating wiring of an electronic component such as a semiconductor device. As clearly stated in the present application on page 4, lines 26-27, the presence of Ag in plated wiring “does not have any adverse effect on the electrical conduction property”. Accordingly, there is no motivation for its removal. However, the present inventors have discovered that even slight content of Ag in an electroplated film causes the film to be “hard and brittle”. Thus, since wiring of semiconductors is being miniaturized, the plated wiring breaks or disconnects under stress and causes a defect. Accordingly, an unexpected result of reducing Ag content to no more than 0.01wtppm is that plated wiring can be formed that does not readily break and disconnect when placed under stress. The cited references clearly fail to disclose such an unexpected result or need to reduce Ag content to this extreme level.

With respect to the purity of copper sulfate, the present application is clear that as of the date when the present invention was made, copper sulfate is commercially available at a purity level of 95 to 99.9wt%. For example, see page 1, lines 25-26, of the present application, as filed. JP ‘291 (published in 1988) fails to disclose a purity level of copper sulfate, and JP ‘615 (published in 1987) discloses a method of producing copper sulfate of a purity level of 99.0wt%. Accordingly, since at the time of the present invention, commercially available copper sulfate already can be purchased at a 99.9wt% level, there is simply no common sense reason for one of ordinary skill in the art to use the method of JP ‘615 to produce copper sulfate of a 99.0wt% level when it already exists at a 99.9wt% level. According, it would not be obvious, or possible, to use the method of JP ‘615 (whether or not combinable with JP ‘291) to produce the purity level required by claim 1 of the present application.

Still further, the purity level of the present invention is needed particularly because of its use in the formation of miniature plated wiring of semiconductors. Since, JP '615 cannot produce the purity level required for this use, one of ordinary skill in the art has no common sense reason for using the method and resulting copper sulfate of JP '615 (whether or not combinable with JP '291). Accordingly, it would not have been obvious for one of ordinary skill in the art to rely on the teachings of JP '291 and JP '615 in an attempt to arrive at the copper sulfate of the present invention.

For these reasons, Applicants respectfully submit that the rejection of claim 1 as being obvious over JP '291 in view of JP '615 should be removed. Claim 1 is patentable, provides unexpected results, and is not obviated by the cited combination (assuming the cited combination is possible). Applicants respectfully request reconsideration and removal of the rejection.

*B. In the non-final Office Action dated June 25, 2009, claims 7, 9-17 and 19-21 are rejected under 35 USC §103(a) as being obvious over JP 63-210291 A (published August 1988) in view of JP 62-030615 A (published February 1987) and in further view of SU 1726381 (published April 1992).*

With respect to claims 9-11 of the present application, these claims are directed to a copper sulfate and depend from base independent claim 1, discussed above in detail. For the same reasons claim 1 is submitted as being patentable and non-obvious relative to JP '291 in view of JP '615, Applicants respectfully submit that claims 1 and 9-11 are patentable and non-obvious relative to JP '291 in view of JP '615 and further in view of SU '381.

In addition, it should be noted that SU '381 discloses processing of a copper sulfate solution containing Fe with hydrogen peroxide in the presence of a complexing agent (5% solution of nitrilotrimethylphosphoric acid) and thereafter processing the mixture with active

carbon. The Fe content is said to be reduced to 10wtppm to 50wtppm (which corresponds to 0.001wt% to 0.005wt%).

Accordingly, the Fe content disclosed in SU '381 is actually higher (10wtppm to 50wtppm) than the Fe content disclosed by JP '615 ("below" 10ppm). Thus, Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art to modify JP '615 with SU '381 since Fe content is already of a lower amount in JP '615 than SU '381.

Further, the above combination still fails to teach or render obvious copper sulfate having: (i) contents of metalloid element impurities of As, Sb, and Bi of less than 0.1wtppm, respectively; (ii) contents of radioactive elements of U and Th of less than 0.001wtppm, respectively; and (iii) contents of Cr of less than 0.1wtppm. Further, the combination fails to disclose the unexpected results achieved with the Ag, Fe and Ni contents and purity at the levels required by claim 1 for the reasons previously stated. Accordingly, Applicants respectfully submit that claims 1 and 9-11 are patentable over JP '291 in view of JP '615 and in further view of SU '381. Applicants respectfully request reconsideration and removal of the rejection for these claims.

With respect to independent claims 7 and 15 of the present application, these claims are directed to a method requiring the steps of: (i) dissolving copper sulfate having a purity of 95 to 99.5 wt%; (ii) subjecting this to active carbon treatment **and** solvent extraction; and (iii) realizing recrystallization to produce copper sulfate having the characteristics recited in claim 1 and discussed above in detail.

As discussed above, JP '291 and JP '615 are based solely on electrolysis and fail to disclose the characteristics of the copper sulfate produced. Further, they clearly fail to teach active carbon treatment, and they clearly fail to teach solvent extraction. SU '381 discloses

active carbon treatment; however, this treatment is to a mixture including hydrogen peroxide and a complexing agent. Accordingly, the solution being treated in SU '381 is clearly different from that required by claims 7 and 15 of the present application.

Still further, none of the cited references discloses a step of solvent extraction which is necessary in combination with the active carbon treatment to reach the levels of refinement required by claims 7 and 15 of the present application (as well as claim 1 of the present application). For at least this reason, Applicants respectfully submit that claims 7 and 15 of the present application are patentable and non-obvious over JP '291 in view of JP '615 and further in view of SU '381.

In addition, Applicants respectfully submit that it would not have been obvious to one of ordinary skill in the art at the time of the present invention was made to combine the cited references. The materials of the anodes/cathodes and the use of low/high current requirements of JP '291 and JP '615 are different as discussed above. Thus, it would not be obvious to combine these processes in a manner maintaining and yielding the desired results. Also, while JP '291 and JP '615 are directed to electrolysis, SU '381 is not and provides a totally different method that would not be obvious to combine with either process disclosed in JP '291 or JP '615. Thus, it would not be obvious to one of ordinary skill in the art how to combine these processes assuming they could even be combined.

Finally, the combination of JP '291 and JP '615 is already said to produce a Fe content of "below 0.001wt%" (i.e., "below" 10ppm). Thus, one of ordinary skill in the art would not find it obvious to combine SU '381 with these references because SU '381 discloses a method for reducing Fe content to 0.001wt% to 0.005wt% (i.e., 10ppm to 50ppm). This is an increase in the amount of Fe and one of ordinary skill in the art relying on common sense would have no reason



to apply the teachings of SU '381 to the combination of JP '291 and JP '615 which is said to already yield a Fe content of "below" 10ppm.

Accordingly, Applicants respectfully submit that independent method claims 7 and 15 and dependent method claims 12-14 and 16, 17 and 19-21 are patentable and are not obviated by the cited combination (assuming the cited combination is even possible). Applicants respectfully request reconsideration and removal of the rejection.

C. *In the non-final Office Action dated June 25, 2009, claim 18 is rejected under 35 USC §103(a) as being obvious over JP 63-210291 A (published August 1988) in view of JP 62-030615 A (published February 1987) and in further view of SU 1726381 (published April 1992) and yet in further view of U.S. Patent No. 4,288,304 issued to DeMarthe et al.*

Applicants respectfully submit that for the same reasons discussed above in detail that independent claim 15 is patentable and non-obvious relative to JP '291 in view of JP '615 and further in view of SU '381, Applicants respectfully submit that dependent claim 18 is patentable and non-obvious relative to JP '291 in view of JP '615 and further in view of SU '381 and yet still further in view of the DeMarthe et al. patent.

DeMarthe et al. disclose a process for extracting zinc from an ore containing sulphur and zinc containing ore. Thus, it fails to provide any useful information to one of ordinary skill in the art with respect to a method of producing copper sulfate.

Accordingly, Applicants respectfully submit that method claims 15 and 18 are patentable and are not obviated by the cited combination. Applicants respectfully request reconsideration and removal of the rejection.

## **II. Conclusion**

In view of the above amendments and remarks, Applicants respectfully submit that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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